Projective mapping based on choice or preference: an affective approach to projective mapping

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Abstract

This work explored a new affective approach to projective mapping, based on consumer's choices or preferences. Two sessions, one week apart, were performed with the same consumers, using whole bread as case study. Overall liking ratings (OL) were gathered in blind conditions and samples were also profiled by QDA. Three projective mapping tests were performed in different scenarios. Consumer's categorization and description of products were explored when consumers based their positioning on the products similarities and differences (analytical approach, "classic napping") both in blind and informed conditions, and when consumers were focusing on their preference or choice (affective approach). The affective approach to projective mapping successfully allowed to unveil consumers' drivers of liking and choice, from a holistic perspective, where consumers summarized their main drivers for categorizing products as they would do when choosing, based on their preferences.

Keywords: napping; projective mapping; affective projective mapping; consumers; drivers; preference; choice.

1. Introduction

Projective mapping (also known as Napping®) followed by a descriptive step has been extensively used in the last years as an alternative tool for the description of products and packs with consumers. It is considered a holistic approach to product profiling, somehow closer to what happens in a choice event when compared to classic descriptive or attribute-based techniques (Varela & Ares, 2012; Valentin et al., 2012). Built on the perception of similarities and differences, it encourages the generation of a global representation of the products, which is usually hindered when consumers are directly asked about multiple particular attributes. Holistic methods enable to identify the main attributes responsible for the differences in the samples without forcing consumers to focus on specific characteristics (Ares & Varela, 2012). In addition, projective methods allow obtaining more spontaneous responses than other more directive techniques (Guerrero et al., 2010). The projective mapping (PM) task can involve the perception of similarities and differences from an intrinsic (sensory) or extrinsic (pack, labelling, etc.) perspective, or both (Carrillo, Varela, & Fiszman, 2012a), generally considering product objective characteristics for categorization rather than liking as main parameter. Nevertheless, consumers often use hedonics or benefit-related terms together with the product and pack descriptive characteristics; which can be relevant for relating product characteristics to marketable features and consumer preferences (Ares & Varela, 2012). This approach has been applied with success to explore sensory and non-sensory stimuli, like the influence of packaging information as nutritional and health claims on consumers' perception (Carrillo et al., 2012a; Carrillo, Varela, & Fiszman, 2012b; Miraballes et al., 2014; Varela et al., 2014).

When optimizing food products, the general practice has been to ask consumers about liking while the sensory properties would be characterized in parallel by a trained panel, in a preference mapping type of exercise (van Kleef et al. 2006). However, trained assessors may describe the product differently, so sensory characterization based on consumers direct input might potentially have greater external validity (Ares & Varela, 2012). In this sense, overall liking (OL) has been gathered together with PM data in some studies for concluding on drivers of liking (Ares et al, 2010; Torri et al., 2013) and to better understand the changes in hedonic response in different mapping scenarios (Carrillo et al., 2012b). In a study by Ares et al. (2011), consumers were asked about their ideal product to be mapped, after doing a PM with real samples of powdered orange juice. The results were similar than those of external preference mapping. Withers at al. (2014) have used taxonomic sorting, a holistic method also based on sample categorization, to generate diagnostic sensory data directly from target consumers by external preference mapping. Generally, hedonic descriptions or OL have been considered as supplementary variables in PM data.

From a different perspective, King, Cliff & Hall (1998) compared PM to a “structured PM” to map snack bars, where they used labeled axes in the PM space: the x-axis was defined as “liking” (low - high) and the y-axis as “use” (treat - meal replacement). They found the proposed method less discriminating than PM, but only 24 consumers participated in this study. To our knowledge, there have not been other approaches to PM from an affective perspective, with liking or preference explicitly driving the categorization of the samples.

Consumers in affective tests act in an integrative fashion, basing on a global sensory and non-sensory stimulation from the product - in contrast to the analytical testing frame of mind in descriptive testing (Lawless & Heymann; 2010; Jaeger, 2006). More concretely, since consumers are integrated and organised wholes, as highlighted by Maslow (1954), in real buying and eating situations they take a certain number of attributes (sensory and non-sensory) into account when performing food choices or declaring their preference (Asioli et al., n.d.). Thus, consumers would cognitively focus on products differently when describing, than when stating their preference or choice. With this background it is of great interest to study how consumers approach the PM task when preference or choice is used as a criterion.

The objective of this study was to explore a new affective approach to projective mapping, with bread as case study, basing product categorization on consumers' choice or preference, and to compare it to the classic preference mapping approach. This approach might provide information that is more realistic for product developers and marketers during the process of product development and launch in the market.

2. Materials and methods

2.1 Samples

Eight commercial wholegrain, pan-loaf breads were used in the study, bought in supermarkets of the south of Oslo region (Norway). Products differed in terms of brands, prices, mix of grains used and percentage of wholegrain (Table 1).

2.2 Descriptive Analysis with a trained panel

A trained panel of nine assessors at Nofima Mat (Aas, Norway) performed a sensory descriptive analysis according to a quantitative descriptive analysis (QDA) as described by Lawless and Heymann (2010) as generic descriptive analysis. The assessors were tested, selected and trained according to ISO standards (ISO, 1993), and the sensory laboratory used followed the ISO standards (ISO, 1988). The assessors agreed upon 25 attributes describing the bread samples: odour intensity, hue, colour intensity, whiteness, pore size (crumb), amount of seeds/fibres (crust), roughness, elasticity, strength, crumbling, cohesiveness (using the finger), acidic taste, sweetness, saltiness, bitterness, yeast flavour, grain flavour, nut/seed flavour, roasted flavour, rancid flavour, hardness, juiciness, roughness/coarseness, chewiness and stickiness. All attributes were evaluated on unstructured line scales with labelled endpoints going from "no intensity" to "high intensity". In a pre-test session, the assessors were calibrated on samples that were considered the most different on the selected attributes typical for the breads to be tested. Samples were served in transparent Ziploc® bags labelled with three-digit numbers. Tap water was available for palate cleansing. Two replicates were performed for each bread sample. All samples and replicates were served in randomised order following a balanced block experimental design.

2.3 Consumer tests

Two sessions, one-week apart, were held with the same group of participants and the same eight samples at Nofima Mat (Aas, Norway). In the first session, consumers performed two “classic” PM tests: blind PM (tasting blind samples) and informed PM (tasting together with the pack). In the second session, consumers first rated blind overall liking and after that, they performed a PM task based on choice or preference, in informed conditions (tasting together with the pack). In both sessions new samples with new codes were delivered for the two tests; consumers had a 15 minutes break between tests.

2.3.1 Consumers’ sample

The consumers included in the study (n=50) were recruited from Nofima’s consumers database, they were frequent consumers of wholemeal bread (more than twice per week). The participants were between 34 and 64 years old (43y.o in average). Each session lasted around 30 min (Figure 1).

2.3.2 Session 1 – Classic PM, blind and informed

All participants were instructed in the use of the PM technique with a descriptive step. The basics of the technique were explained to the participants through an example employing geometric shapes with different colours and patterns, without any mention to breads. After the explanation of the technique, the participants received an A2 sheet of paper to allocate the samples. Samples were allocated according to the principle that samples with similar characteristics should be placed close to each other, while different samples should be placed farther away. Next, they had to write all the terms they perceived in connection with each sample, or group of samples, on the sheet, beside the position of the respective samples (technique also known as ultra-flash profiling).

Blind PM

The eight bread samples were presented simultaneously for direct comparison. Each sample was presented in a transparent Ziploc® bag coded with 3-digit numbers on a sticker. This type of presentation facilitated the location of the samples on the A2 sheet. The participants had to observe, smell and taste the breads, and then placed the samples on the A2 sheet. Once they decided on the positioning, they should write the codes on the sheet, and write the terms describing the perceived characteristics of the sample or group of samples close to the corresponding code.

Informed PM

The participants simultaneously received the eight bread samples as in the blind test, but this time each with an accompanying scan of the original front-of-pack (FOP), printed in colour. All scans of the FOP had the same dimensions. The participants performed the test in the same way as in the blind test, but this time they had to consider both the information received, and the sensory characteristics perceived. As before, they had to position the codes of the samples on the A2 sheet, and write the descriptive terms.

2.3.3 Session 2 (one week apart) – Blind overall liking rating and informed PM based on choice or preference (PM-C)

Blind overall liking rating

Consumers rated their overall liking in 9-point box hedonic scales. Samples were evaluated in blind conditions in a rotated presentation balanced for order and carry-over effects (Wakeling & MacFie, 1995).

Informed PM based on choice or preference (PM-C)

Samples were presented the same way as in the informed PM (bread samples with an accompanying front-of-pack), but using different codes. The instructions of this test differed from the "classic" PM approach in the way in which consumers had to base their categorization and sample allocation. Instructions were as follows: "*Please evaluate the samples and look at the packs and position them on the sheet according* *to their differences and similarities basing your criteria on what you would choose, thinking about different food occasions. Place them on the sheet in such a way that two samples are close to each other if they're similar with regards to your preference and two samples are far from each other if they are different with regards to your preference*." As in the other two tests, consumers had to write the codes of the samples on the A2 sheet together with descriptive terms.

These instructions were fine-tuned through a pilot test session, and subsequent open discussion with the consumers participating in the trial (n=10). As an example, a reference was added in the instructions stressing "*what you would choose, thinking about different food occasions"* to avoid consumers thinking they should rank the samples from most to least preferred, and take the decision on only one consumption situation. In this way they understood they could for example like two or more breads equally, but decide to consume them in different occasions or for different applications. Also, the categorization basis was stressed when instructing them to place samples as "*two samples are close to each other if they're similar with regards to your preference"* (and conversely). In this sense, an example was given to the consumers by using a very different food category: sweet foods/desserts where the possibility of giving multiple reasons behind their choice was further explained. In the example consumers had different desserts like fresh fruit, yogurt, a gooey cake, etc. so they better understood the idea.

2.4. Data analysis

2.4.1 Analysis of the trained panel data

Analysis of variance (ANOVA) using a two-way model with interactions and with the assessor and interaction effects considered random, was performed on the descriptive sensory data from the trained panel in order to identify the sensory attributes that discriminated between samples. A PCA on the average of the sensory descriptive data (significant attributes, $p < 0.05$) was performed (mean centred data, no standardisation).

2.4.2 Analysis of the consumer tests data

Analysis of variance (ANOVA) was performed on consumer overall liking scores considering consumer and sample as sources of variation. Mean ratings were calculated and significant differences were checked using Fisher's LSD test ($p < 0.05$). Agglomerative hierarchical clustering (HCA. Dissimilarity: Euclidean distance; Agglomeration method: Ward's method) was utilized as segmentation procedure in order to highlight groups of consumers with different liking patterns. Furthermore, an internal preference mapping was achieved via PCA (Principal Component Analysis) of a matrix of products x consumers, for obtaining a multidimensional representation of products and consumers in order to check against the clustering results (Varela, 2014). Analysis of variance (ANOVA) and Fisher's test were also run for the clusters obtained, same way as above.

PM data in the three scenarios were collected as the X and Y coordinates of the samples on each consumer's individual map. A Multiple Factor Analysis (MFA) was performed considering the X and Y coordinates for the samples on each consumer's individual map as a group of variables (Pagès, 2005). Confidence ellipses were constructed as in Delholm et al. (2012). MFA was also carried out to compare the bread sample positions on the maps generated in the four evaluations. Values of RV coefficient were obtained for comparing data from each session. RV ranges between 0 and 1; the closer to one, the greater the similarity between the configurations of the data tables.

To study if consumers grouped/mapped the samples differently in the three PM sessions, an MFA was conducted for the three tables for each consumer. Then the variability between the consensus of the three sessions was measured by the similarity index proposed in (Tomic et al) . The similarity index (SI) for individual k (k = 1, …, n) is computed as:

$$SI_k = \frac{1}{n}\sum_{i=1}^{n}\frac{\|F_{ki} - F_k\|}{F_k}$$

Here $\| \|$ is the frobenius norm, F_k the consensus obtained with A=2 components for consumer k, and F_{ik} the projected coordinates of consumer k from session i (i=1,2,3). The SI aims to measure the variation around the consensus, and it is clear from the equation above that higher SI values indicate that the consumer maps samples different in the three sessions. There is no upper limit on SI, but a value > 1 indicates that residuals are larger than the variation between the samples within the consensus. The SI can also be computed for the complete data set in one session to measure the overall agreement of the consensus.

All the words provided by the participants in the description phase of the PM were analyzed qualitatively. The terms generated to describe the samples were grouped by consensus between two researchers, considering synonymous and derived words. Terms mentioned by at least 5% of the consumers were retained for further analysis (Symoneaux, Galmarini, & Mehinagic, 2012). The frequency table containing the terms was considered as a set of supplementary variables in the MFA of the PM data. The frequency of mention was determined by counting the number of mentions of the same term in each session.

Global Chi-square was used for testing homogeneity of the contingency table of the terms generated in the descriptive step of the PM in the three scenarios (Symoneaux et al., 2012). When the initial Chi-square was significant, a chi-square per cell was done within each cell identifying the source of variation of the global Chi-square.

The MFA analyses from the PM data were performed with the package FactoMineR (http://factominer.free.fr/) in R (version 3.2.2).

The chi-square per cell analysis was run with an XL macro as in Symoneaux et al. (2012).

The rest of the statistical analyses were run in XLStat statistical software package 2014, Addinsoft, New York.

3. Results

It is important to point out that the objective of this methodological research was not to draw conclusions on the products themselves, but on how the different approaches to PM (analytical and affective) influenced on the product descriptions, and product choice information.

3.1. Overall Liking & liking patterns

Overall liking (OL) significantly varied between bread samples (Table 2), ranging from 4.1 to 5.9. Preference responses are usually heterogeneous, and mean scores are not always representative of real preference patterns (MacFie, 2007; Felberg et al. 2010). Preference mapping approaches could be applied to understand consumer preference patterns and together with sensory data, to look for underlying dimensions that drive consumer preferences (Varela, 2014). In this first section, hierarchical cluster analysis (HCA) and the sensory description via generic descriptive analysis by the trained panel were combined to understand the liking patterns. Cluster analysis could be seen as "the lowest level of preference mapping" (Mac Fie, 2007).

HCA highlighted three clusters, one of them composed of only 5 consumers who rejected all samples (scores 4 and under). Considering they disliked the general category under study, the analysis was continued on the other 2 clusters. Table 2 displays the distinct liking patterns of those two clusters. Although both groups of consumers rejected sample **B8**, liking patterns were clearly different. **B8** (barley, extra-coarse)**,** was described by the trained panel as with a somehow strange, rancid flavor that could have explained the general consumer rejection.

Cluster 1 was less discriminating among samples, they rejected **B8** and did not present significant differences in overall liking amongst the rest of the samples, they were fairly open to any kind of bread but slightly preferred whiter, more cohesive breads.

Consumers in cluster 2 on the other hand, had more defined preferences, favouring dark, rough breads, and rejecting whiter, less coarse varieties. **B1** (wholegrain, half-coarse) and **B5** were top liked, which were described as with intense odor, bitter, with nut/seed and roasted flavour, rough, with big pores and dark; followed by **B2** and **B7** (rye, extra-coarse), described as chewy, rough, sweet, roasted, dark and strong. They clearly rejected **B3** and **B4** (whiter, cohesive, sticky, crumbling, with yeast taste, grain taste and salty), added to the rejection of **B8**.

These liking patterns could also be observed by looking into the multidimensional representation of products and consumers in an internal preference map (Figure 2).

In the following sections the obtained two clusters will be explained by the descriptive data obtained by PM with consumers, to contrast with the interpretation provided by the QDA. The conclusions that can be drawn with preference mapping approaches, using classic descriptive data and overall liking together, are limited to the sensory drivers of liking or disliking. The use of projective techniques as PM may allow for getting a description further than sensory terms, so preference mapping approaches based on PM can unveil other reasons behind the affective response patterns (Ares et al., 2011; Varela & Ares, 2012).

3.2. Classic PM vs the new affective approach for understanding consumers perception

3.2.1. Perceptual spaces - spatial configurations

Comparisons of the four evaluations

Sample configurations in the four tasting instances (descriptive analysis with the trained panel and the three PM with consumers) were highly correlated, with RV coefficients ranging from 0.86 to 0.97. QDA presented the lowest RVs with respect to all the PM scenarios, but they were still good (0.86). This can also be appreciated from the superimposed representation of the samples in the multiple factor analyses (Figure 3). For most of the samples, QDA was further away in the perceptual space to the consensus, but still keeping a similar relative positioning between samples. These results suggest that consumers might react similarly when assessing products blindly and informed, and even when basing on their preference rather than on the products' descriptive characters. Moreover, the high correlations to QDA indicate that the assessments are mostly based on the sensory aspects.

In the descriptive step of blind PM , consumers generated 75 different terms in total to describe the sample set, comprising mainly sensory terms (47) but also hedonic and some related to usage and attitudes. In the descriptive step of the informed PM, consumers generated also 75 different terms in total, again a majority of sensory terms (42) and some hedonic and related to usage and attitudes. The fact that consumers focused more on sensory cues to describe similarities and differences between the samples rather than on usage or others goes in accordance with the high correlation obtained with the QDA and both classic PM tests.

In the descriptive step of the PM based on choice or preference, consumers generated approximately the same amount of different terms in total (78), however, in this scenario the number of sensory terms was significantly lower (28) and the description was more focused on the usage and attitudes category of terms (39). This shows that although the positioning of the products in the perceptual space might have been similar, the associations consumer made when thinking about their preference or choice for different consumption occasions was different, and mainly driven by the usage and the situation, rather than by specific sensory cues.

Blind PM

Figure 4 shows the perceptual spaces as described by the two first dimensions of the MFA of the two classic PM in both scenarios (blind and informed). In the blind PM (Figure 4 a1 and a2), the two first dimensions of the MFA display 50% of the variability of the original data. Looking together into samples configuration (Figure 4 a1) and their description (Figure 4 a2), the breads were grouped mainly based on cereal type (oats, rye, barley, with wholegrain and combinations middle-way in the map), as well as fibre content and healthiness perception. Consumers attached a healthier perception to the samples described as coarser and with more seeds taste (**B7**, **B5**, **B1**), while attached a more standard or ordinary characters to the softer samples towards the other side of the first factor.

Informed PM

In the informed, classic PM: it is clearly visible from the sample configuration (Figure 4 b1), that the information polarized the results obtained for sample **B8**, which was separated from the rest of the samples in the consensus configuration. Evidently, the somehow unique characteristics of this sample, particularly the "off-flavour" described by some in the blind PM evaluation (Figure 4 a2) - in line with the "rancid" in QDA - made more sense in consumer minds when knowing more about this bread, and together with mentioning the base cereal (barley and claims), they focused more on describing the bad, off-taste, and mapped it further away than the rest. As B8 spans factor 2 of the MFA; the other samples do not show much variation in this direction. The first factor showed the variation of samples "from rye (**B7**) to oats (**B6**, **B4**)" with the wholegrain and mixes in the middle. However, variations in coarseness and darkness are seen in this factor. The breads perceived as less coarse, or whiter are located towards the right of the plot. It is interesting to see, that the information on the whole grain content, did not noticeably affect the perception of coarseness, attached to **B7** and **B5** (extra coarse), but also to **B1** (half coarse).

PM based on choice or preference PM (PM-C)

Figure 5 displays the perceptual space obtained in the PM-C in informed conditions, as described by the two first dimensions of the MFA. Although the relative positioning of the samples in the spatial configuration was not essentially changed, an enhanced discrimination between the products can clearly be observedin this scenario. Samples

B6 and **B4,** both made mainly with oats, were the only ones not discriminated in this tasting instance. In the PM-C consumers used more words, and less were on sensory descriptions. The extra information obtained with this type of PM approach can be appreciated in Figure 5 by interpreting the particular description of each sample (descriptive step), which can also be used to better understand the liking patterns as highlighted by consumers. As an example, Cluster 2 preferred samples **B1**, **B2**, **B5** and **B7**, described in PM-C as dark, tasty, with good texture, a good/exciting taste, with corn, seeds and taste of seeds, sour, coarse, heavy, satiating, rich in fibre, healthy, sporty, for adults, of a known brand, somehow expensive, good for dinner, with soup or cheese, and they would buy them. On the other hand, consumers in Cluster 1 tended to like more chewy breads with smooth surface, without whole seeds, not as coarse, with oats, less tasty or even bland, good when toasted, a low price, everyday bread, for lunchbox, easily eaten, for families, for children. Meanwhile, there characteristics were rejected by cluster 2. The PM-C also helped to further understand the rejection of **B8** by all consumers. It was described as not attractive, with bad, strange taste, off-flavour and odour, bitter, fluffy and porous and it was perceived as unhealthy, consumers stated they would not buy this kind of bread. This supports the idea of the differentiated drivers of consumers' description in this case, by the usage occasions and the situation, and only some important sensory cues

Descriptive step

Table 3 shows the list of terms mentioned by consumers in the three PM scenarios together with the Chi Square per cell analysis. The terms included in the analysis were the ones cited at least by 10% of the consumers for one product.

With respect to the ***sensory terms*** generated, even if there was a comparable number of different terms cited in the blind (47) and informed PM (42), the frequencies of citation were in general higher in the blind tasting, as consumers relied mostly on the sensory characters for explaining their maps. The terms mentioned the most in the blind PM (with more than 40 mentions) were: bland, bright colouring, coarse, corn, dry, seeds/taste of seeds. In the informed PM, the sensory terms were less in total, but the most mentioned were mainly the same, however, juicy and smooth surface became also important in this scenario to describe the samples. In the PM-C, the total number of sensory terms was significantly lower (28) and the terms elicited by consumers with high frequency were less. The words bland, corn and dry were still mentioned more than 40 times, but significantly less frequently than in the blind scenario. However, coarseness was mentioned significantly more frequently, going from 44 mentions in the blind PM to 106 mentions in the affective approach (PM-C); this suggests coarseness might have been one of the most important drivers of product differentiation when thinking about choosing, in this particular sample set.

The ***hedonic terms*** category was the one with less distinct terms generated by consumers in the three PMs, and the frequencies were also lower. In general, in the blind PM there were significantly more terms regarding liking or disliking of some sensory characteristics, as: exciting appearance, good smell, standard appearance and standard texture, however the number of mentions were low (25 or less). The hedonic term most mentioned in the three PM was good/exciting taste, but there were no differences between them (86-101 mentions). It is quite interesting how two of the hedonic terms significantly increased in the PM-C, bad taste and would not buy/eat/uninterested became very important in the affective approach, which suggests that consumers were more prone to express their opinions with regards to disliking when grouping the samples based on what they would choose.

The category of descriptions on ***usage & attitudes*** was the one more influenced by the scenario. The number of different terms generated in total more than doubled in the affective approach to PM (from 15 in blind to 39 in the affective approach), and the frequencies of mention of usage & attitudes terms were significantly higher. The terms generated included: target consumers (for kids, for adults, for family), consumption occasions (for breakfast, lunch, dinner, everyday bread, for lunch-box, for sport), food pairings (for soup, with cheese, with toppings, with jam, versatile), health related properties (healthy, satiating, weight reducing), references to the brand (good label, standard label), and to the price (expensive, low price). It is interesting to highlight how the price references were almost inexistent in the classic PM scenarios (both blind and informed), and how the references to healthiness increased significantly, further than focusing much more in the possibilities of usage of the product.

Chi square per cell was also run on the term by product matrix in each scenario, to being able to highlight the different profiles of each sample (data not shown). As stated above, the main objective of this paper was not to describe the samples, but the the study shown that the terms generated by each individual product in the affective PM highlighted the important attributes for each sample at the light of the different preference patterns. As an example, **B8** was associated significantly more frequently with the terms would not buy, bad taste, weird taste, off flavour, sour taste and non-informative label. Hence it becomes clear why the product was rejected by most consumers, highlighting the drivers of disliking. On the contrary, **B5**, the bread liked by both groups of consumers, was associated more frequently as with a good/exciting taste, tasty, with good smell and good tasting crust, and consumers found it both good as lunch box bread and also sporty. In terms of coarseness, it was significantly associated with this concept, but not significantly different to **B7**, which was at the same time significantly more seen as a dark bread, for adults and highly satiating. This suggest that **B5** could be a good option for both clusters within the coarser breads, while **B7** was very well liked by Cluster 2 but within the less liked in Cluster 1.

3.4. Consumers' individual behaviour in the different PM scenarios

A natural question that might be raised at this point is how different consumers, or groups of consumers, reacted to the change in PM scenario. When comparing how samples were located in the perceptual spaces by both liking clusters in the different tests, they were also very similar; for example comparing the relation of the perceptual spaces obtained by clusters 1 and 2 in the PM-C, RV was 0.882. Something similar happened when comparing the outcomes for the same cluster throughout scenarios; for instance, Cluster 1 had an RV of 0.828 between PM blind vs PM-C. These results showed that the maps obtained for the groups with similar liking patterns were quite stable throughout different PM tests. However, that was not necessarily the case when studying consumers' individual behaviour. Some of the consumers changed their maps drastically from one scenario to another, while some others maintained their mapping structure very stable throughout evaluations. Figure 6 presents the MFA plots comparing the three evaluations for the two consumers that presented the best (C118) and worst (C121) agreements between sessions. Consumer C118 performed a highly similar comparative allocation of the samples in the three perceptual spaces, with high RV coefficients (RV inf-blind= 0.71; RV choice-blind= 0.76; RV inf-choice= 0.86). On the contrary, the perception of the samples for consumer C121 shifted importantly from scenario to scenario, with very low RV coefficients (RV inf-blind= 0.1; RV choice-blind= 0.1; RV inf-choice= 0.04). To have an overall view of the consumer sample, the SI (similarity index) coefficients were calculated for each of the participants (Tomic, Berget & Naes, 2015). SI takes a value of zero when configurations are the same as the consensus scores, and the higher the value, the lower the similarity. Figure 7 shows the distribution of SI values for all the consumers, ranging from 0.47 to 1.11, most consumers had SI values between 0.6 and 0.8. Few consumers have a much worse or much better fit than the rest. This shows that there are relatively small individual differences here as compared to the Tomic example, where SI values were as higher as 4.5.

4. General Discussion

The fact that consumers might react similarly when mapping products based on their preferences or choice as compared to when they do based on the products' descriptive similarities or differences, and that these mappings might be mostly based on the sensory aspects, was somehow initially surprising. Carrillo et al. (2012a, 2012b) had similar findings when comparing results of classic blind and informed PM on biscuit samples, hypothesising that product information is in fact a ‘‘modulator’’ of consumer perception, meaning that the perception is basically one which would be modulated depending on the context the consumer experienced. In this way, individual sample characterization would vary within the perceptual space but the sample multivariate structure (distance and relative positioning among products) would not vary dramatically. The same authors found that the changes observed presented a sample-dependant effect. This was also the case in the present work. When looking into figures 4 and 5 is evident that samples **B2**, **B5** and **B8** shifted positions considerably more than the rest of the samples, while the overall structure of sample configuration remained stable. In particular, **B8** was assessed as very different from the rest (polarizing effect) when evaluated with information, both in the informed PM and in the PM-C. This shift might have happened because of being the only sample that contained barley, and because of its on-pack nutritional and health claims (B-glucans, lower cholesterol, long lasting satiety). Carrillo et al. (2012a) mentioned a sample-dependant change in perception linked to nutritional and health claims, particularly when those claims were not completely understood by consumers. Added to this, other authors have highlighted the importance of the fit carrier-claim (Krutulyte et al., 2011), and how the perceived carrier-ingredient fit is related to the familiarity with the combination and to the healthiness of the carrier food (Carrillo et al., 2012b). Barley, even if not an unknown ingredient in bread for Norwegian consumers, has been re-introduced in the Norwegian market in many new products accompanied by the communication of various health and nutritional effects. B-glucan is also quite a new functional ingredient for the Norwegian market.

The reported stability of sample configurations in blind and informed conditions, also shown by the present study, and the modulator effect of the context of the test, make sense in an analytic descriptive framework. This is because consumers use the available information to sort samples in a bi-dimensional perceptual space, which would be subsequently modified by the extra information received through the pack. Further to this, the results of this and previous works using PM in different scenarios, suggest this basic perceptual structure in consumers' minds would be determined mainly by the product sensory cues and attuned by the extrinsic product information. This modulation is expressed by tweaking the map, and mainly by using specific and distinct characteristics in the descriptive step. It would be worthy to study the effect (or not) of this modulation in other type of studies, for example in conjoint approaches, as compared to PM, looking into the interaction of intrinsic and extrinsic product cues. In those tests, the information is usually displayed on a computer screen, with all variables with the same salience, which could potentially lead to an overestimation of the influence of certain parameters on food choice, as previously suggested by Varela et al. (2014).

The idea behind this method and some of the results of the present study were presented in Eurosense 2014 and for different reasons not published until now. In the meantime, we had the chance to conduct a second study using PM-C and to compare it to CATA, to evaluate consumers' perception of a complex set of stimuli as aromatically enriched wines. In that recently published work (Lezaeta et al., 2017), working with 150 consumers, we observed that both consumer-based methods highlighted the positive effect of aromatic enrichment on consumer perception and acceptance. However, PM-C generated a very detailed description in which consumers focused less on the sensory aspects and more on the usage, attitudes, and reasons behind their choices, providing a deeper understanding of the drivers of liking/disliking of enriched Sauvignon Blanc wines. This new work confirmed what we suggested in the proof of principle, which we now detail in this work.

However, before these two studies, there was no experience with changing the cognitive framework when realising PM, from an analytic mapping to an affective mapping, and our results suggest that consumers would be somehow performing a “preference mapping in their heads”. To accomplish this aim, they would first map the products, as they would do in a classic PM, and they would subsequently state their preferences via the descriptive step, for example by the description of usage and attitudes characters much in detail. More work would be needed using this technique to assess if this is generalizable to other cases. It is also possible that the affective frame of mind allowed a better differentiation between the samples, through a combined effect of the modulation of the extrinsic characteristics and the personal meaning added to the different product dimensions (hedonic perception, usage, attitude, brand perception, etc.). In Lezaeta et al. (2017), we indeed saw that PM-C stretched the perceptual space further as compared to CATA, with PM-C discriminated better among the wine samples.

In the 1998 paper by King et al. where they compared free and structured projective mapping (with liking as one of the axis) for identification of similarity-of-use of snack bars, they did not obtain a better sample discrimination through the structured PM. It could have happened that a too structured mapping scenario, with predefined categories, prevented consumers to freely express their perception, sorting the products into rather obvious groups instead of detailing their hedonic perception. Torri et al. (2013) studied how different groups of consumers realised a classic PM test with wines, where product differentiation by consumers was poor. They separated the consumers in three groups depending on their performance and concluded that an increased differentiation ability was observed for those consumers able to match the duplicate samples in the PM test, and that their main mapping dimension was highly correlated to their liking. Even if consumers were asked to describe the samples and no indication of using liking as criteria was given, it might have been that the high complexity of the samples pushed some consumers into using their hedonic perception as a basis for categorization. Those consumers were able to get a better discrimination, which would be in agreement to what was reflected by our work.

The descriptive step in the affective approach to PM provided a much richer description than the classic approach, in terms of drivers of preferences. Consumers expanded on the reasons behind sample categorization and their choices, covering things as target consumers, consumption occasions, possibilities of usage, food pairings, health related properties, brand associations and references to the price and willingness to buy/not buy. Consumers also highlighted their drivers of rejection or disliking more in depth in that scenario.

5. Conclusions

The results of the perceptual spaces obtained in this work comparing PM in blind and informed conditions were quite comparable, suggesting sensory cues were the main driver for the categorization. In the PM based on choice, consumers focused less on the sensory aspects and more on the usage & attitudes, generating a more detailed description. In this way, the affective approach to PM provided an enhanced understanding in terms of the drivers of liking/disliking, appearing as a promising tool for category and market exploration.

The limited number of consumers used in this study (n=50) did not allow to draw conclusions about implications for the bread category in the Norwegian market, although this was not an objective of this work, but a proof of principle of the approach. However, the clear differences found when comparing the PM make these data strong enough from a methodological point of view, to suggest this new approach to PM could add up interesting information when looking into consumer feedback on drivers of liking and reasons behind their choices. More research is needed on further product categories to better understand the complete picture.

It is indeed interesting how PM-C, allowed for this “unfolding” on a seemingly 2-step processing and conveying of the information: firstly a sensory description followed by an in depth hedonic and behavioural description, this deserves further research.

It will be also worth following up the individual differences and group behaviour in the PM-C which has also been pinpointed by some latest methodological studies in classic PM (Varela et al., 2014; Vidal et al., 2016; Varela et al., 2017).

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Table Captions

Table 1.- Bread samples included in the research

Table 2.- Mean OL ratings and Fisher LSD ($n=50$, Analysis of the differences between the categories with a confidence inteRVal of 95%)

Table 3.- Descriptive step in the three PM evaluations. Chi square per cell analysis. The analysis was run in the complete data table. Data are displayed in three groups (sensory terms, hedonic terms and usage and attitudes terms) for better understanding.

(+) or (-) indicate that the observedvalue is higher or lower than the expected theoretical value. *** $p < 0.001$,** $p < 0.01$ and * $p < 0.05$; effect of the chi square per cell

Figure captions

Figure 1.- Workflow of experiments

Figure 2.- Internap preference map, (a) product plot and (b) consumers and attrubutes plot

Figure 3.- Superimposed MFA representation of the eight samples. Each sample is represented by four points, corresponding to the four evaluation instances (QDA, PM Blind, PM Informed, PM Choice). The consensus representation is represented for each of the samples as the central point.

Figure 4.- Multiple factor analysis of the data obtained in the two classic PM scenarios. (a1) Representation of the samples in the PM Blind; (a2) Representation of the terms in the PM Blind; (b1) Representation of the samples in the PM Informed; (b2) Representation of the terms in the PM Informed.

Figure 5.- Multiple factor analysis of the data obtained in PM based on choice. Representation of the samples (left) and the terms (right)

Figure 6.- Superimposed MFA representation of the eight samples, corresponding to the three PM evaluation instances, for two individual consumers. Consumer with best agreement on the left (RV inf-blind= 0.71; RV choice-blind= 0.76; RV inf-choice= 0.86) and the consumer with the worst agreement on the right (RV inf-blind= 0.1; RV choice-blind= 0.1; RV inf-choice= 0.04).

Figure 7.- Barplot showing the similarity index (SI) for all consumers. The values are sorted so that the leftmost consumers have the smallest variation across the different sessions, whereas the rightmost have large variation across the sessions.

Figure 1
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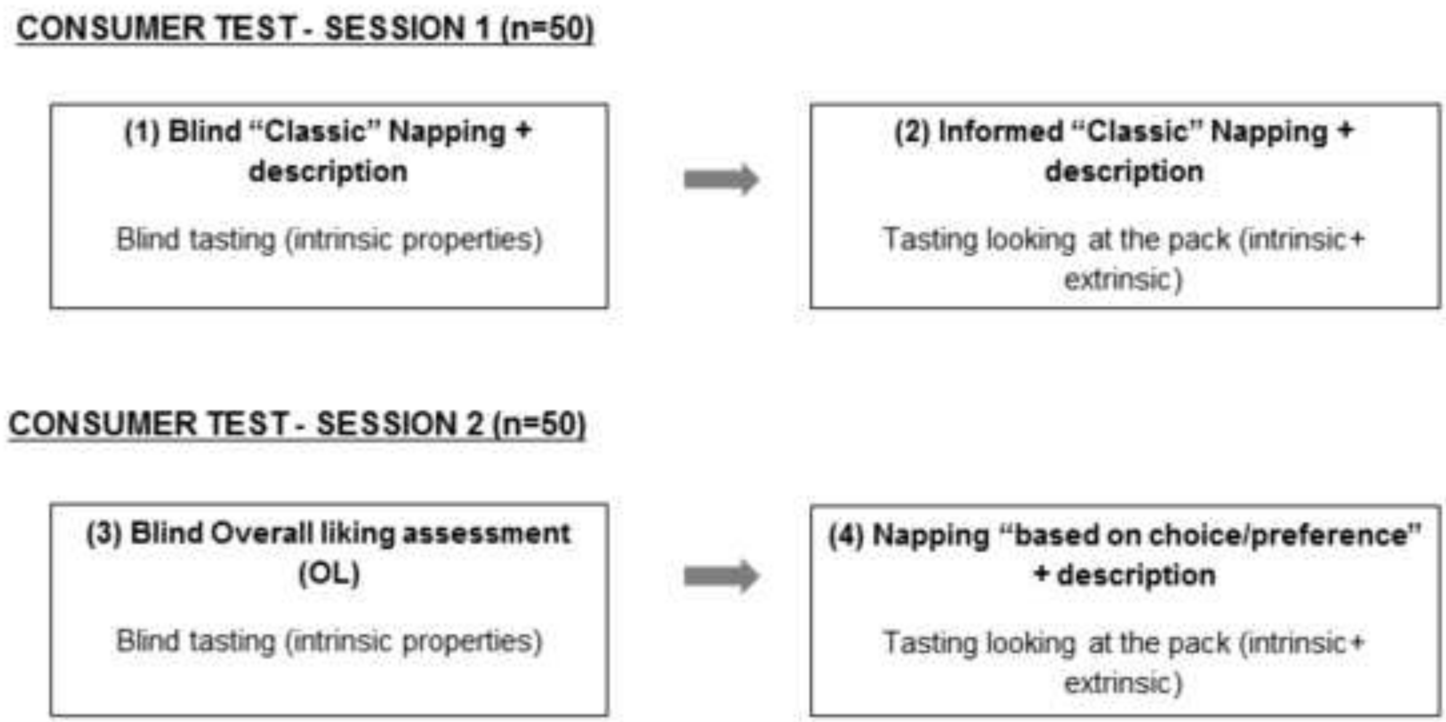

Figure 2a
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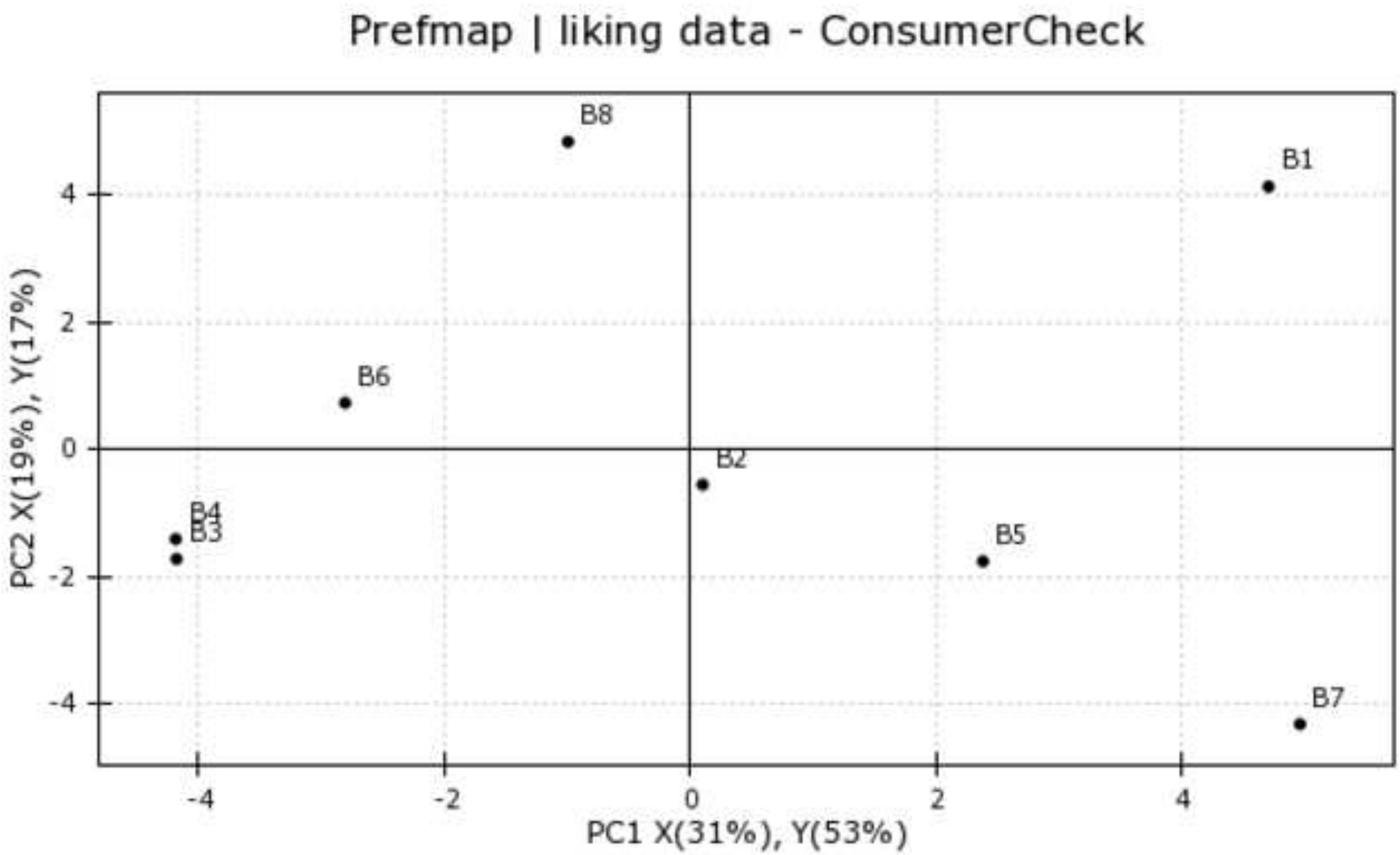

Figure 2b

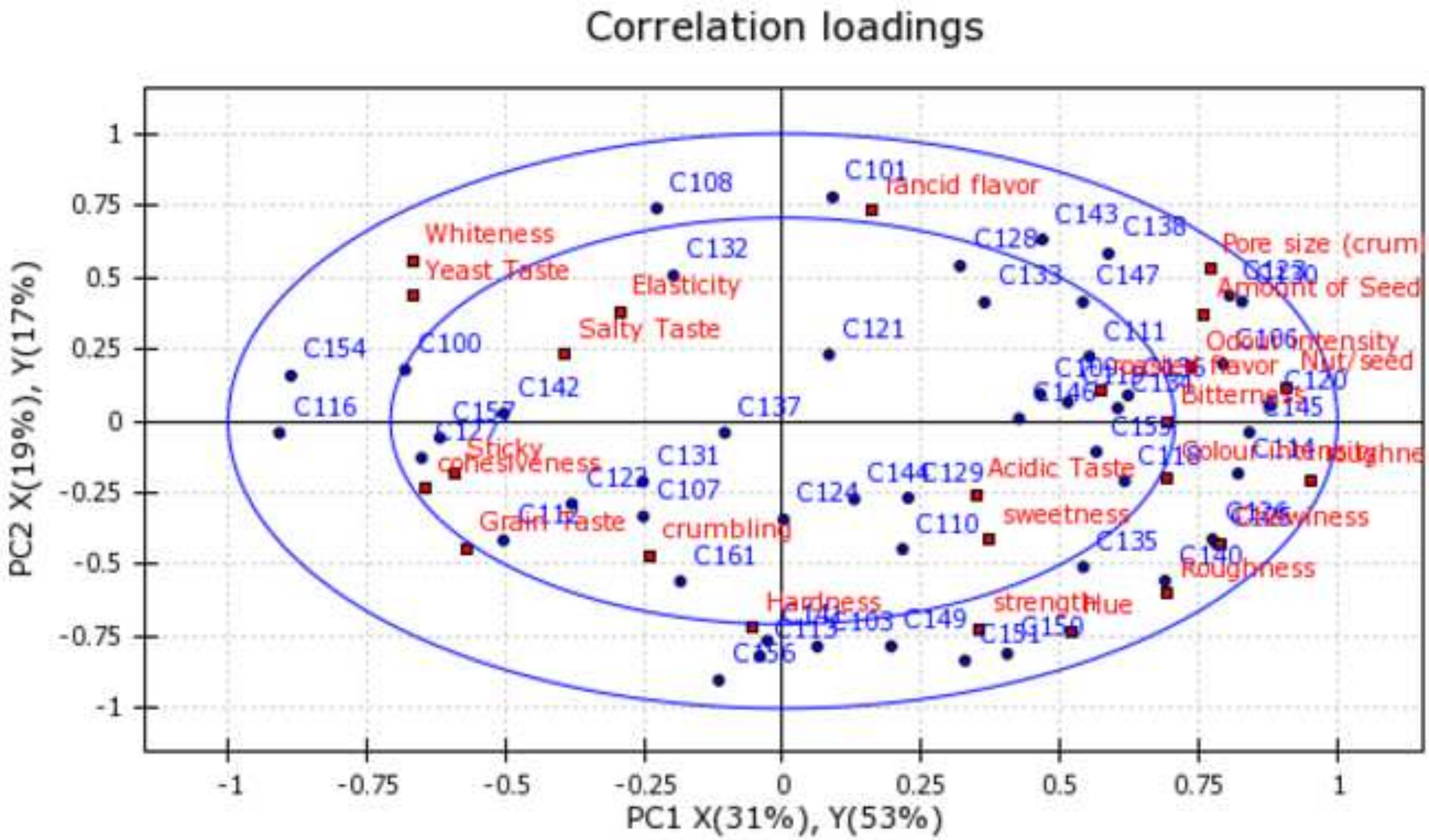
Correlation loadings
PC2 X(19%), Y(17%)
PC1 X(31%), Y(53%)
1
0.75
0.5
0.25
0
-0.25
-0.5
-0.75
-1
-1
-0.75
-0.5
-0.25
0
0.25
0.5
0.75
1
C108
C101
rancid flavor
C143
C138
C128
Whiteness
Pore size (crum
C132
Yeast Taste
C133
C147
Elasticity
Amount of Seed
Salty Taste
C121
C111
C154
C100
Odour intensity
Nut/seed
C142
C120
Bitterness
C116
C137
C145
C157
C127
C155
Sticky
C131
cohesiveness
C122
C144
C129
Acidic Taste
C107
C124
C110
sweetness
Grain Taste
crumbling
C135
C161
Roughness
Hardness
C149
strength
Hue
C113
C151
C150

Figure 3

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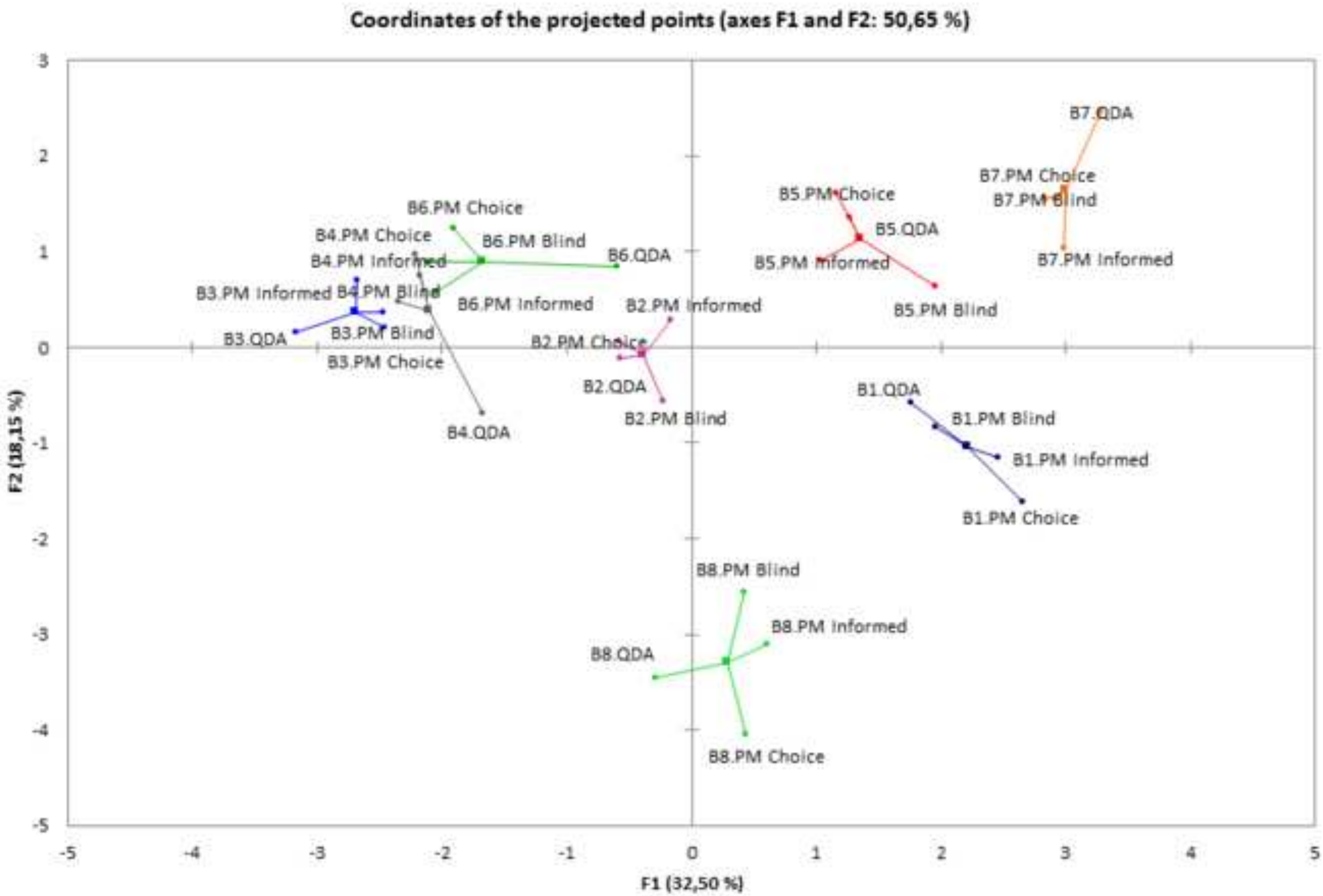

Figure 4

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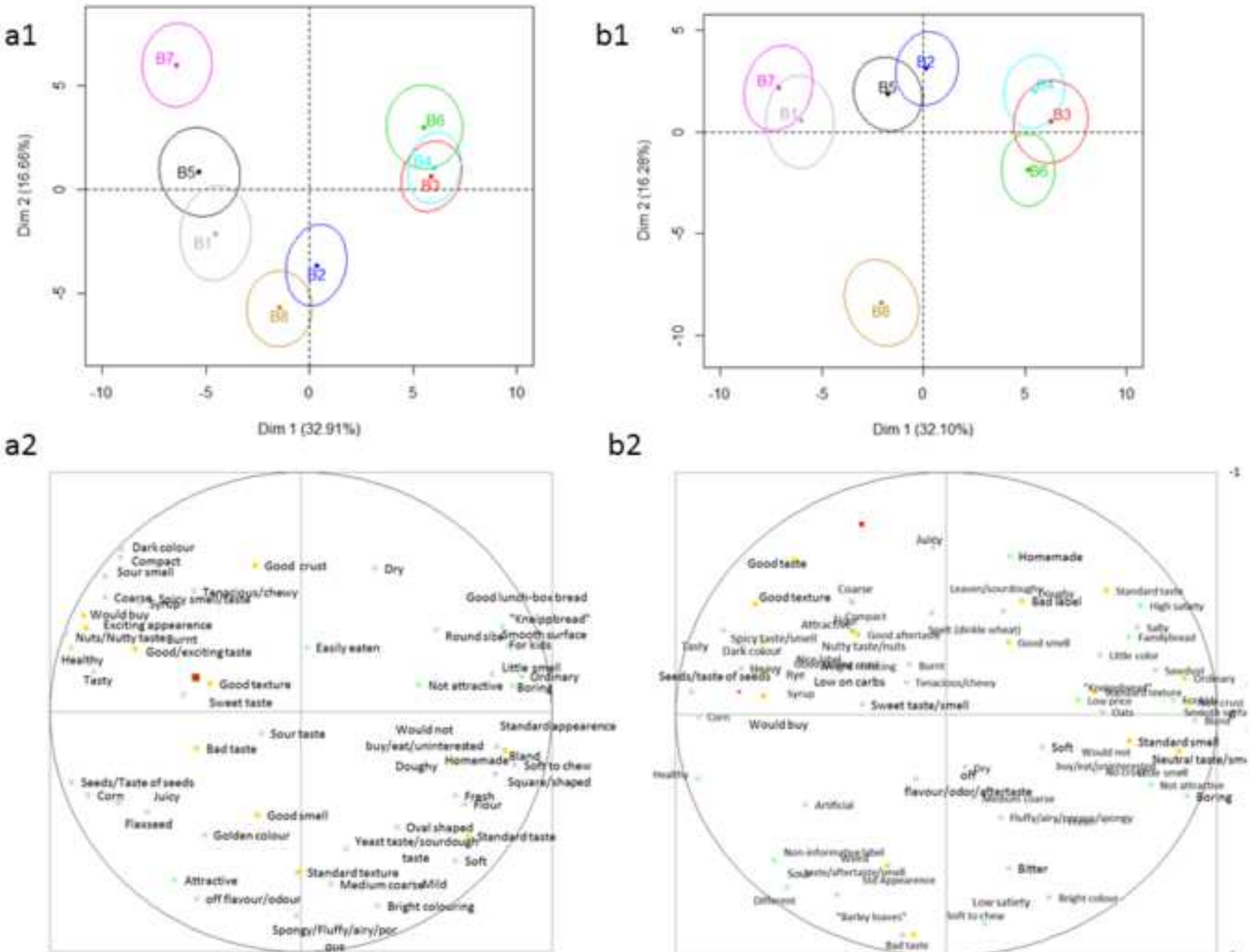

Figure 5

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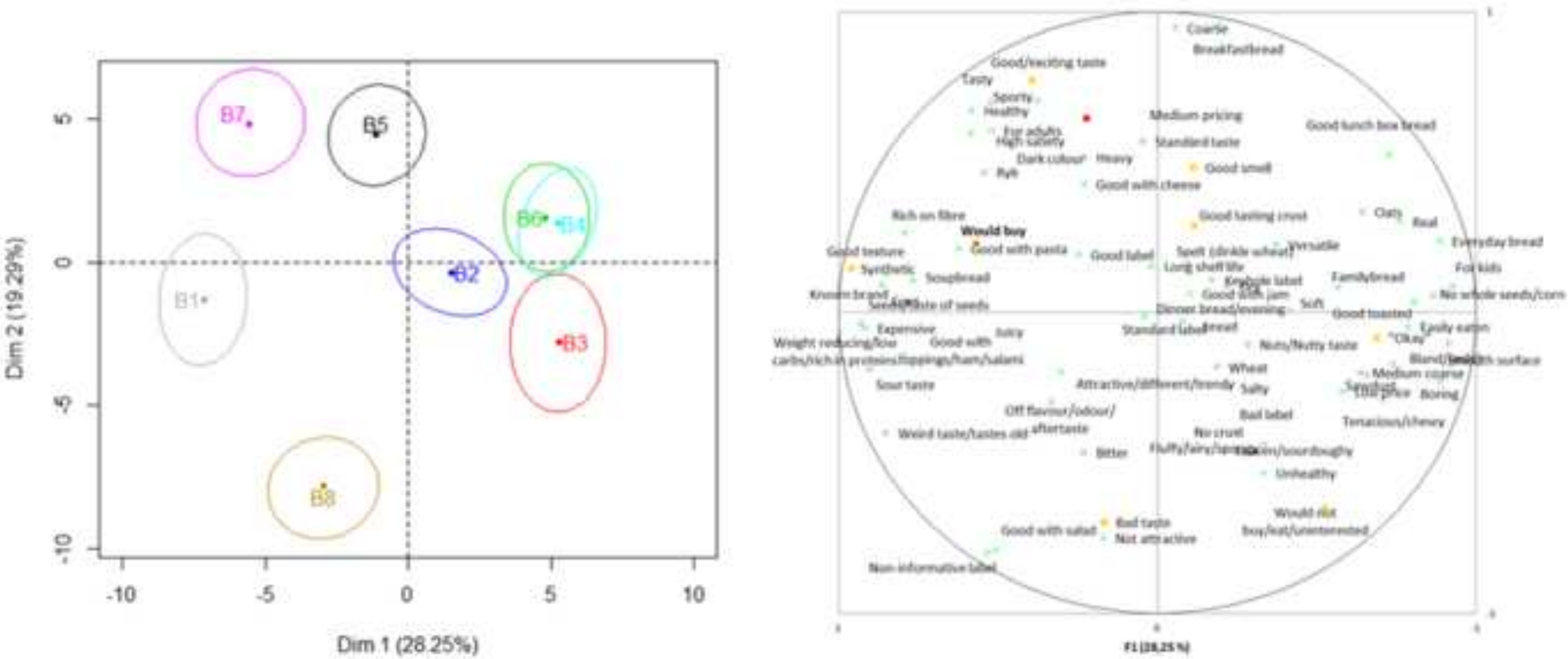

Figure 6
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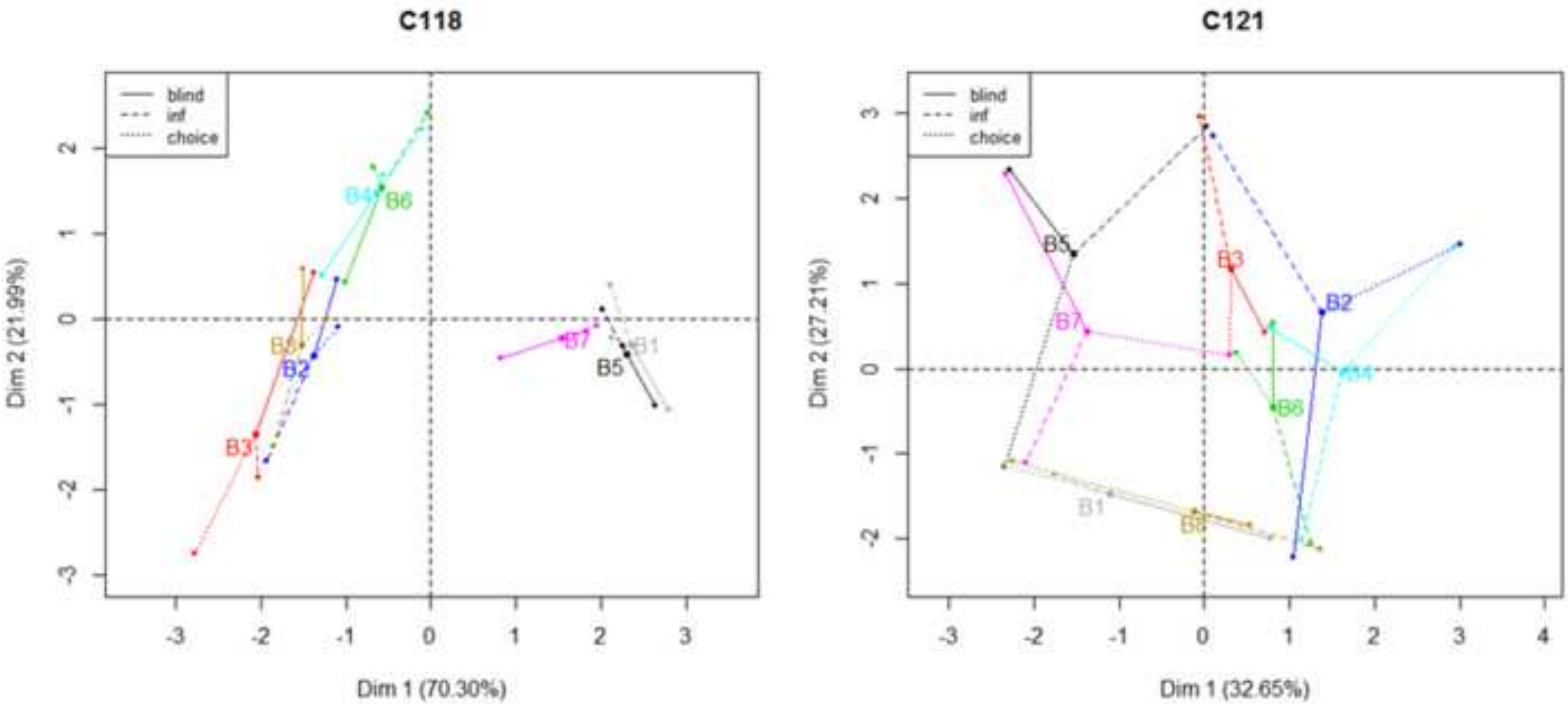

Figure 7
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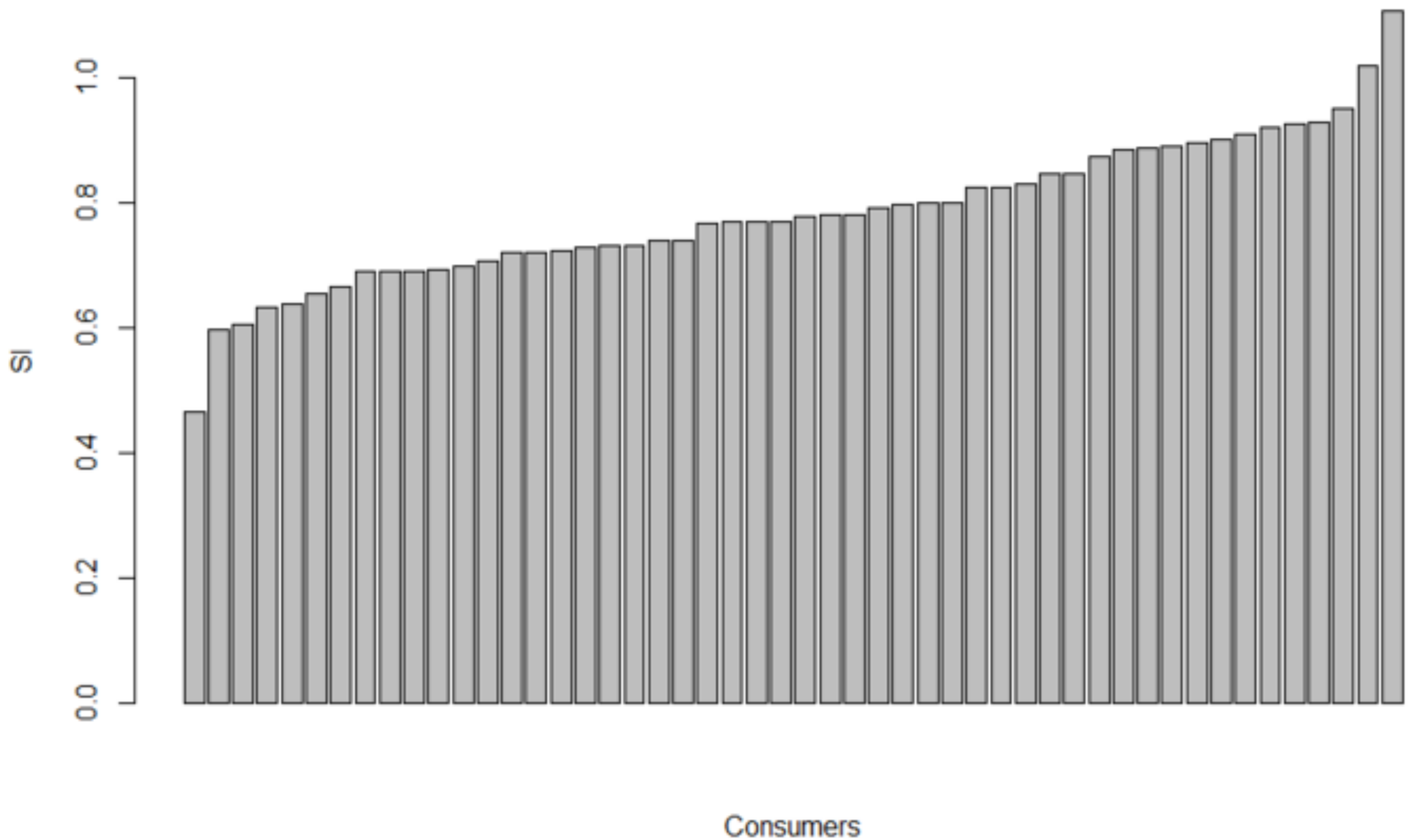

Table 1

Table 1.- Bread samples included in the research

Sample	Type of bread	Half-Coarse 25-50% whole grain	Coarse 50-75% whole grain	Extra coarse 75-100% whole grain	Keyhole label	Claims
B1	Wholegrain	x				Balance. Protein rich, less carbohydrates, “smart-carbo”, high fiber, beneficial fats, stable blood sugar
B2	Dinkle Wholegrain		x		x	
B3	Wholegrain		x		x	
B4	Wholegrain with oats			x	x	
B5	Wholegrain with oats and rye			x	x	Sport bread. Gold recipe. The taste of success is unbeatable
B6	Oats			x	x	High fiber
B7	Rye			x	x	Healthy and well, good for the body. Long lasting satiety, health & taste winner. High fiber
B8	Barley			x	x	B-glucans, lower cholesterol, Long lasting satiety, norwegian grain

Table 2

Table 2.- Mean OL ratings and Fisher LSD for the whole group and the two clusters

Bread Sample	OL all consumers (n=50)	OL Cluster 1 (n=20)	OL Cluster 2 (n=25)
B1	$5.6^{a,b}$	$4.5^{a,b}$	6.8^{a}
B2	5.8^{a}	5.3^{a}	$6.2^{a,b,c}$
B3	$4.7^{c,d}$	5.0^{a}	4.4^{d}
B4	$4.9^{b,c}$	5.4^{a}	4.4^{d}
B5	5.9^{a}	5.0^{a}	6.7^{a}
B6	$4.9^{b,c}$	$4.8^{a,b}$	$5.1^{b,c,d}$
B7	$5.1^{a,b,c}$	$4.0^{a,b}$	$6.3^{a,b}$
B8	4.1^{d}	3.2^{b}	$4.9^{c,d}$

Table 3

Sensory	PM1	PM2	PM3	Hedonic	PM1	PM2	PM3	Usage & Attitudes	PM1	PM2	PM3
Bitter	3 (-) *	13 (+) *	10	Bad label	0 (-) **	8	14 (+) **	Attractive	32	26	20 (-) *
Bland	88 (+) ***	67	51 (-) ***	Bad taste	13 (-) ***	17 (-) **	69 (+) ***	Boring	64	80 (+) *	58 (-) *
Bright colour	52 (+) ***	30	0 (-) ***	Exciting app.	6 (+) ***	0	0	Breakfast bread	0 (-) **	0 (-) **	22 (+) ***
Coarse	44 (-) ***	68	106 (+) ***	Good tasting crust	7	5	3	Dinner bread	0	0	6 (+) **
Compact	14	17 (+) **	0 (-) ***	Good size	2	3	0	Different	3	9 (+) **	0 (-) **
Corn	78 (+) **	63	48 (-) ***	Good smell	25 (+) ***	17	3 (-) ***	Easily eaten	4	0 (-) **	11 (+) **
Dark colour	28 (+) ***	13	5 (-) ***	Good/exciting taste	86	101	92	Everyday bread	0 (-) ***	0 (-) ***	31 (+) ***
Doughy	8 (+) *	6	0 (-) **	Good texture	21	23 (+) *	6 (-) ***	Expensive	0 (-) ***	0 (-) ***	32 (+) ***
Dry	73 (+) ***	48	44 (-) **	Nice label	0 (-) *	9 (+) ***	0 (-) *	Family bread	0 (-) **	7	10
Flaxseed	6 (+) ***	0	0	Okay	0 (-) **	0 (-) **	22 (+) ***	For adults	3	0 (-) **	13 (+) ***
Flour	13 (+) ***	4	0 (-) **	Standard app.	17 (+) ***	6	0 (-) ***	For kids	12	8 (-) *	26 (+) **
Fluffy/airy	33	39 (+) *	17 (-) ***	Standard taste	30	38	42	Good label	0 (-) *	0 (-) *	12 (+) ***
Fresh	8 (+) *	6	0 (-) **	Standard texture	10 (+) **	5	0 (-) **	Good lunch box bread	7 (-) *	0 (-) ***	39 (+) ***
Heavy	3	9 (+) *	3	Would buy	7	7	26 (+) ***	Good toasted	0 (-) *	0 (-) *	11 (+) ***
Juicy	24	42 (+) ***	12 (-) ***	Would not buy	9 (-) ***	11 (-) ***	82 (+) ***	Good with cheese	0	0	6 (+) **
Kneippbread	18 (+) ***	8	0 (-) ***					Good with jam	0	0	4 (+) **
Little smell	15 (+) ***	9	0 (-) ***					Good with toppings	5	0 (-) *	9 (+) *
Medium coarse	13	6	9					Healthy	15 (-) ***	37	96 (+) ***
Mild	18 (+) ***	0 (-) **	0 (-) **					High satiety	4 (-) *	10	17 (+) *
Neutral taste/smell	0 (-) *	12 (+) ***	0 (-) **					Homemade	5	8 (+) *	0 (-) **
No crust	0 (-) *	7	7					Keyhole label	0 (-) ***	6	28 (+) ***
Nuts/Nutty	11	6	9					Known brand	0	0	6 (+) **
No whole seeds	0 (-) ***	0 (-) ***	26 (+) ***					Low price	4 (-) **	4 (-) **	30 (+) ***
Oats	4	6	16 (+) **					Low satiety	0	8 (+) ***	0 (-) *
Off flavour	11	10	14					Non-informative label	0 (-) **	7	9
Rye	0 (-) **	9 (+) *	6					Not attractive	7	13	7
Oval shaped	6 (+) ***	0	0					Ordinary	16 (+) *	15 (+) *	0 (-) ***
Round size	5 (+) ***	0	0					Soupbread	0 (-) *	0 (-) *	12 (+) ***
Salty	4 (-) *	18 (+) ***	7					Sporty	0 (-) *	0 (-) *	14 (+) ***
Sawdust	0	4	4					Standard label	0	0	8 (+) ***
Seeds	47 (+) **	35	26 (-) **					Versatile	0 (-) *	0 (-) *	11 (+) ***
Smooth surface	17 (-) *	43 (+) ***	24					Weight reducing	0 (-) **	4	11 (+) **
Soft	29 (+) ***	11	6 (-) ***								
Soft to chew	6	5	0 (-) *								
Sour smell	11 (+) ***	0 (-) *	0 (-) *								
Sour taste	16	20	16								
Spelt	0 (-) ***	9	15 (+) **								
smell/taste	10	14 (+) **	0 (-) ***								
Square/shaped	9 (+) ***	0 (-) *	0 (-) *								
Sweet taste	11	12 (+) *	0 (-) ***								
Syrup	8	10 (+) *	0 (-) **								
Tasty	20	20	12 (-) *								
Tenacious/chewy	28	26	15 (-) **								
Weird taste/smell	0 (-) **	10 (+) *	9								
Yeast taste	7 (+) ***	0	0 (-) *								

*Graphical Abstract
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